MACHINE-GENERATED DISPLAYS OF WELL LOGS AND LITHOLOGY FROM 12 WELLS ON THE NORTH SLOPE OF ALASKA

By

Kenneth J. Bird
U.S. Geological Survey
Menlo Park, California

Open-File Report
82-290

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

Menlo Park, California
February 1982

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INTRODUCTION

Mechanical well log and lithology information stored on magnetic tape is used to produce computer-generated plots which offer a compact summary (display) of multiple log curves and rock types. This paper is one of a series concerning displays for 81 North Slope Alaska wells, and provides background information on the displays, location of the wells, details of modifications to the original log curves, origin of the lithology column, and explanation of the symbols. These displays, designed by L. B. Magoon and myself, are products of a contract between the U.S. Geological Survey and Petroleum Information Corporation (PI).

These 81 North Slope well displays, 70 of which are from the National Petroleum Reserve in Alaska (NPRA), are being released in a series of six Open-file Reports by this author. Five of these reports, previously released, include 69 displays (Bird, 1981a-e). This, the sixth report, presents the remaining 12 displays of wells from NPRA and the east-central North Slope (plates 1-12) which are tabulated on the list (table 1) and located on the map (fig. 1).

DISPLAY

The display format shows a heading positioned above a lithologic column which is flanked on the left by gamma-ray and spontaneous potential curves, and on the right by resistivity, sonic, density, and differential caliper curves. The vertical scale is 1 in. per 100 ft. An overall width of 9.5 in. allows the display to be printed on commercial log paper. The generalized format is designed to be compatible with a variety of applications including correlation (see Tetra Tech, Inc., 1980, Geologic Report) and other data displays (see geochemical displays of Magoon and Claypool, 1980). The reduced scale precludes engineering calculations, but the digital form of the data allows plotting at any desired scale. Magnetic tape with the digital data is available from PI in Denver, Colorado. All log curves have been digitized from paper logs, or, on more recent wells, recorded digitally at the well site. Depth intervals without log curves on the display indicate that no log was run. The following paragraphs discuss each component of the display format.

Heading information (obtained from well completion reports or individual logs) consists of:

- --well name;
- --American Petroleum Institute (API) identifying number;
- --surface location in terms of section (SEC), township (T), and range (R);
- --total depth (TD) as measured by the driller; and
- --elevation of either the kelly bushing (KB) or derrick floor (DF), points from which all well depths are measured.

The gamma-ray curve (GR) is expressed in standard API units. The GR scale range may differ from well to well, with variations in intensity affected by changes in borehole diameter. GR readings for recent wells have been corrected for this affect, with appropriate notations in the title block.

The spontaneous potential curve (SP), with a scale range of 0 to 200 millivolts (mv), has been expanded on some displays to 0 to 100 mv to achieve more precise bed definition. Manual shifts and baseline drift have been removed. Inverse-reading SP, a result of the use of high salinity mud, has been reversed to make the SP appear normal.

The lithology column shows interpretive rock type and rock thickness in symbols explained in figure 2. The interpretation is my own and was arrived at by comparison of log response with descriptions of cores and drill-cuttings from various sample logs. This comparison provides a calibration of log response to rock type and allows more accurate discrimination of rock type and bed thickness than the use of sample logs alone. Minimum bed thickness in the display is limited to 10 ft by the inability of the machine to plot symbols closer than one-tenth of an inch. Because of this limitation, many thin beds recognized in cuttings, cores, and logs are not shown. Two sets of unlabeled depth ticks are plotted, one on each side of the lithology column. On the left edge of the column each tick represents 100 ft and on the right, 100 m. The depth marks start at zero at the top of the column which represents the elevation of either the kelly bushing (KB) or derrick floor (DF).

The resistivity curve (RES), with logarithmic scale in ohms m^2/m, is one of two or three resistivity logs that are run. The shallow-reading resistivity log (usually the laterolog 8) is used in the display for maximum bed definition.

The speed of sound through rock (SONIC) is expressed by the next curve. The units are microseconds per foot. In some displays a "smoothing" function has been applied to the curve to eliminate spurious readings such as "noise" and cycle-skipping.

The bulk density curve (DENSITY), in grams per cubic centimeter, is obtained from the compensated gamma-gamma density log. The tool is sensitive to borehole size and changes in size (see differential caliper curve) and many readings are inaccurate. No corrections have been applied to this curve.

The differential caliper curve (DIFF. CALIPER) shows the size (in inches) of the borehole in excess of the bit size. Measurements are obtained from a two-arm caliper run in conjunction with the density or neutron logs. In an elliptical hole, the two-arm caliper is most likely to measure the maximum diameter of the hole.

ACKNOWLEDGMENTS

The discussions and encouragement of L. B. Magoon and his collaboration in the design of the display are gratefully acknowledged. Production of the displays has been accomplished by the efforts of J.P. Mitchell, L. Montgomery, R. Mohundro, and M. Wolfson, all of the PI Energy Services Section.

REFERENCES

Bird, K. J., 1981a, Machine-generated displays of well logs and lithology from selected wells on the North Slope of Alaska: 10 wells from the western part of the National Petroleum Reserve in Alaska (NPRA): U.S. Geological Survey Open-file Report 81-1032, 6 p.

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________ 1981c, Machine-generated displays of well logs and lithology from selected wells on the North Slope of Alaska: 11 wells from the northeastern part of the National Petroleum Reserve in Alaska (NPRA): U.S. Geological Survey Open-file Report 81-1034, 6 p.

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Tetra Tech, Inc., 1980, Summary geologic report fiscal year 1980, prepared by E. C. Guldenzopf and others, Houston, Texas. Unpublished report prepared for the U.S. Geological Survey, Office of National Petroleum Reserve in Alaska.

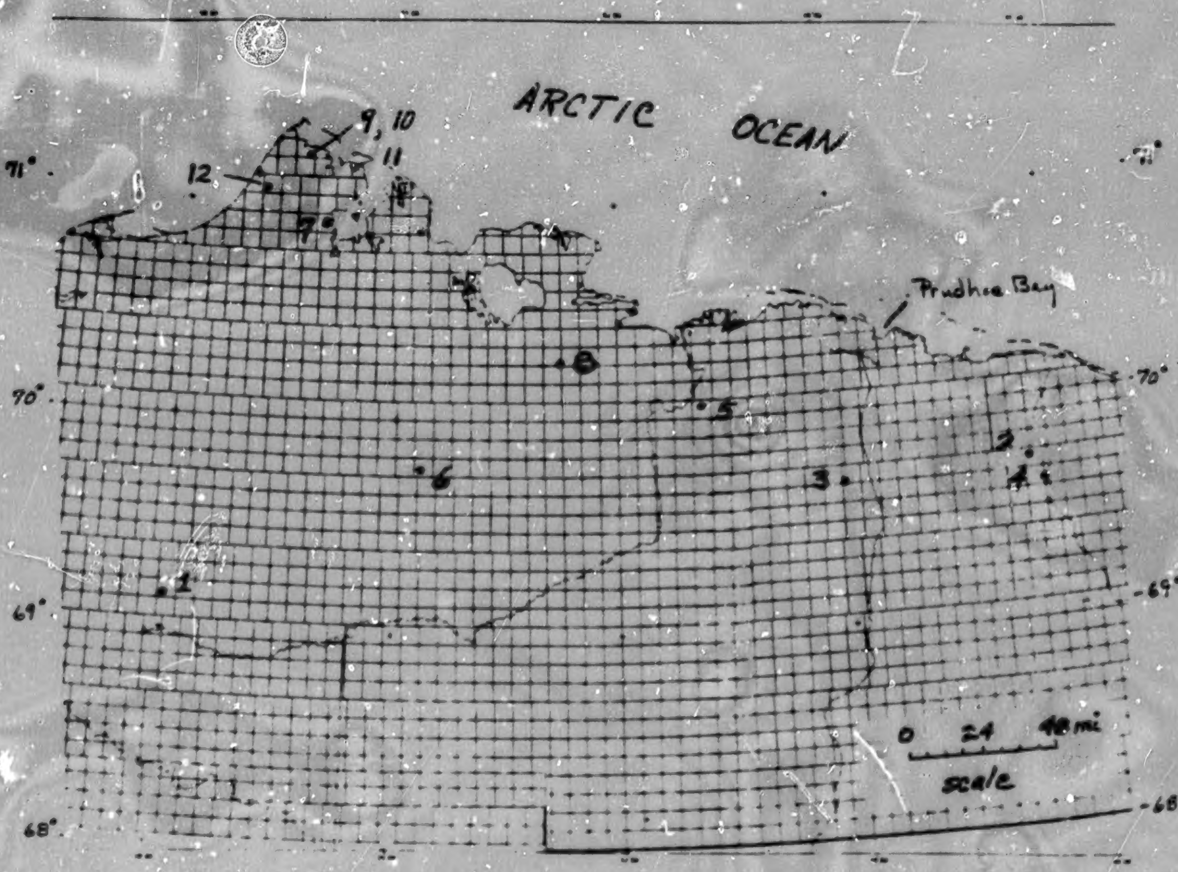
ARCTIC OCEAN
9, 10
11
12
7
8
5
6
3
2
4
1
Prudhoe Bay
71°
70°
69°
68°
0 24 48 mi
scale

Figure 1. Map of part of the North Slope of Alaska showing locations of wells with displays. Well names corresponding to numbers are listed below in table 1.

Table 1. List of wells with displays being released in this open-file report. Numbers refer to map locations (fig. 1) and to display plate numbers.

1. Awuna - 1
2. Beli - 1
3. Bush Federal - 1
4. Canning River - 1A
5. Itkillik River - 1
6. Koluktak - 1
7. Kuyanak - 1
8. North Inigok - 1
9. South Barrow - 15
10. South Barrow - 18
11. Tulageak - 1
12. Walakpa - 2

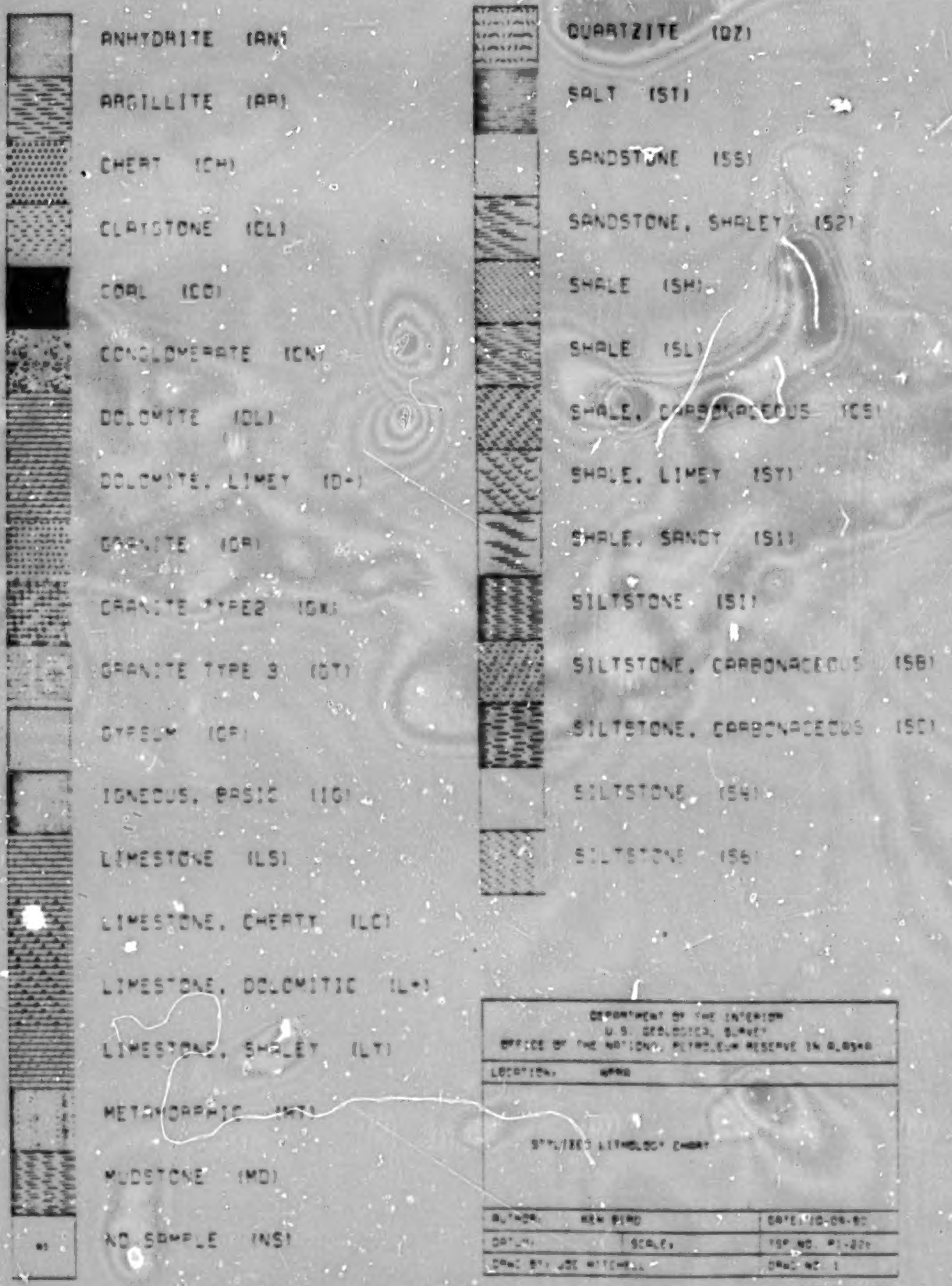
ANHYDRITE (AN)
ARGILLITE (AR)
CHERT (CH)
CLAYSTONE (CL)
COAL (CO)
CONGLOMERATE (CN)
DOLOMITE (DL)
DOLOMITE, LIMEY (D-)
GRANITE (GR)
GRANITE TYPE2 (GW)
GRANITE TYPE 3 (GT)
GYPSUM (GP)
IGNEOUS, BASIC (IG)
LIMESTONE (LS)
LIMESTONE, CHERTY (LC)
LIMESTONE, DOLOMITIC (L*)
LIMESTONE, SHALEY (LT)
METAMORPHIC (MT)
MUDSTONE (MD)
NO SAMPLE (NS)
QUARTZITE (QZ)
SALT (ST)
SANDSTONE (SS)
SANDSTONE, SHALEY (S2)
SHALE (SH)
SHALE (SL)
SHALE, CARBONACEOUS (CS)
SHALE, LIMEY (ST)
SHALE, SANDY (S1)
SILTSTONE (SI)
SILTSTONE, CARBONACEOUS (SB)
SILTSTONE, CARBONACEOUS (SC)
SILTSTONE (S4)
SILTSTONE (S6)
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA
LOCATION: NPRA
STYLIZED LITHOLOGY CHART
AUTHOR: KEN BIRD
DATE: 10-09-80
DATUM:
SCALE:
TSP NO. 81-22
DRWN BY: JOE MITCHELL
DRWG NO. 1

Figure 2. Symbols, name, and two-character code (in parentheses) currently used in the lithologic plotting program.

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Plate 1 of 12

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AWUNA NO. 1

API #50-155-20001
SEC 30 T 3S R 25W
TD 11200 FT., KB 1129 FT.

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

AWUNA NO. 1
BOREHOLE CORR. GAMMA RAY
FDC IN PIPE (8302-10118)

AUTHOR: K. BIRD	DATE: 8-21-81
DATUM: 1129 ASL. SCALE: 1IN=100FT	TSP NO. PI-1P4
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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BELI UNIT NO. 1

API #50-179-20002
SEC 8 T 4N R 23E
TD 14632 FT., KB 1052 FT

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U.S. GEOLOGICAL SURVEY
OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

BELI UNIT NO. 1

BOREHOLE COMP., GAMMA RAY

AUTHOR: K. BIRD	DATE: 6-03-81
DATUM: 1032 ASL SCALE: 1IN:100FT	TRP NO. 81-[illegible]
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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BUSH FEDERAL NO. 1

API #50-223-20004
SEC 31 T 4N R 13E
TD 16090 FT., KB 396 FT.

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U.S. GEOLOGICAL SURVEY
OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

BUSH FEDERAL NO. 1

BOREHOLE CORR. GAMMA RAY

AUTHOR: K. BIRD
DATE: 8-08-81
DATUM: 308 ASL
SCALE: 1IN:100FT
TSP NO. PI-283
DRWG BY: EXPLORATION TECHNOLOGY
DRWG NO.

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CANNING RIVER UNIT A-1

API #50-179-20005
SEC 19 T 3N R 24E
TD 8874 FT., KB 925 FT.

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OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

CANNING RIVER UNIT A-1
BOREHOLE COMP. GAMMA RAY

AUTHOR: K. BIRD	DATE: 6-03-81
DATUM: 925 ASL SCALE: 1IN=100FT	TSP NO. [illegible]-285
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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ITKILLIK RIVER UNIT NO. 1

API #50-103-20003
SEC 10 T 8N R 5E
TD 15321 FT., KB 63 FT.

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OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA	
ITKILLIK RIVER UNIT No. 1 BOREHOLE CORR. GAMMA RAY	
AUTHOR: K. BIRD	DATE: 8-24-81
DATUM: 63 ASL	SCALE: 1IN:200FT
TSP NO. PI-341	
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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KOLUKTAK NO. 1

API #50-119-20001
SEC 27 TWP 5N RGE 11W
TD 5883 FT., KB 205 FT.

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LOCATION: NPRA

KOLUKTAK NO. 1
BOREHOLE CORR. GAMMA RAY

AUTHOR: K. BIRD	DATE: 01-14-82
DATUM: 205 ASL	SCALE: 1IN:100FT
TSP NO. PI-172	
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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KUYANAK NO. 1

API #50-163-20003
SEC 10 T 18N R 16W
TD 6690 FT., KB 28 FT

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OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

KUYANAK NO. 1
BOREHOLE CORR. GAMMA RAY
SP REVERSED 4751 - TD

AUTHOR: K. BIRD		DATE: 7-22-81
DATUM: 28 ASL	SCALE: 1IN:100FT	TSP NO. PI-335
DRWG BY: EXPLORATION TECHNOLOGY		DRWG NO.

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NORTH INIGOK NO. 1

API #50-103-20017
SEC 36 T 11N R 4W
TD 10170 FT., KB 166 FT.

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LOCATION: NPRA	
NORTH INIGOK NO. 1 BOREHOLE CORR. GAMMA RAY	
AUTHOR: K. BIRD	DATE: 8-24-81
DATUM: 166 ASL SCALE: 1IN=100FT	TSP NO. PI-334
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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SOUTH BARROW NO. 15

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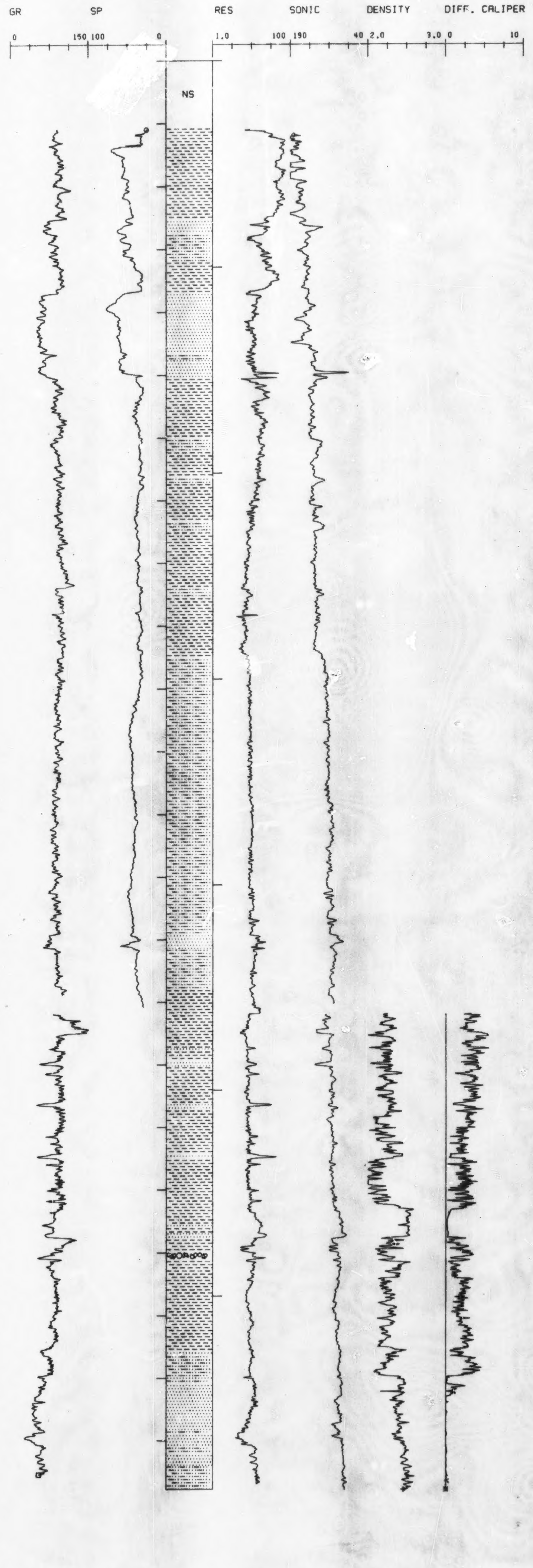
TD 2278 FT., KB 30 FT



DEPARTMENT OF THE INTERIOR U.S. GEOLOGICAL SURVEY OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA		
LOCATION: NPRA		
S. BARROW NO. 15 LOG DISPLAY BOREHOLE CORR. GAMMA RAY		
AUTHOR: K. BIRD		DATE: 5-20-81
DATUM: 30 ASL	SCALE: 1IN:100FT	TSP NO. P1-281
DRWG BY: EXPLORATION TECHNOLOGY		DRWG NO.

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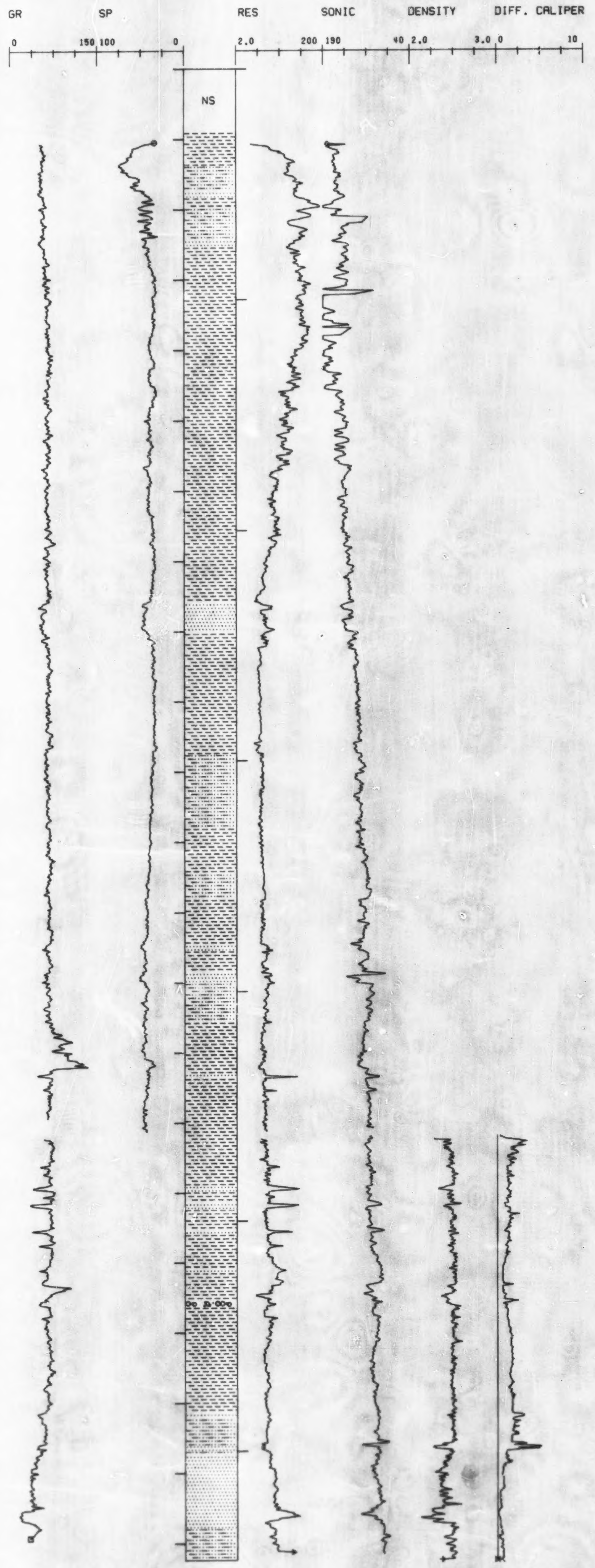
SOUTH BARROW NO. 18

API #50-023-20017
SEC 24 T 22N R 17W
TD 2125 FT., KB 30 FT.



DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

S. BARROW NO. 18 LOG DISPLAY

BOREHOLE CORR. GAMMA RAY

AUTHOR: K. BIRD		DATE: 5-20-81
DATUM: 30 ASL	SCALE: 1IN:100FT	TSP NO. P1-282
DRWG BY: EXPLORATION TECHNOLOGY		DRWG NO.

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TULAGEAK NO. 1

API #50-023-20018
SEC 7 T 21N R 14W
TD 4015 FT.. KB 27 FT.

DEPARTMENT OF THE INTERIOR U.S. GEOLOGICAL SURVEY OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA	
LOCATION: NPRA	
TULAGEAK NO. 1 BOREHOLE CORR. GAMMA RAY	
AUTHOR: K. BIRD	DATE: 8-03-81
DATUM: 27 ASL SCALE: 1IN:100FT	TSP NO. P1-324
DRWG BY: EXPLORATION TECHNOLOGY	DRWG NO.

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WALAKPA NO. 2

API #50-023-20019
SEC 31 T 20N R 19W
TD 4360 FT.. KB 61 FT.

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OFFICE OF THE NATIONAL PETROLEUM RESERVE IN ALASKA

LOCATION: NPRA

WALAKPA NO. 2
BOREHOLE CORR. GAMMA RAY

AUTHOR: K. BIRD		DATE: 8-05-81
DATUM: 61 ASL	SCALE: 1IN:100FT	TSP NO. PI-323
DRWG BY: EXPLORATION TECHNOLOGY		DRWG NO.